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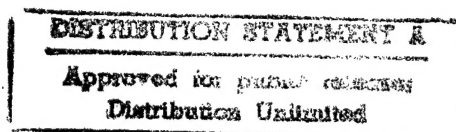
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USSR Report

MATERIALS SCIENCE AND METALLURGY

No. 86



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USSR REPORT
MATERIALS SCIENCE AND METALLURGY

No. 86

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ALUMINUM AND ITS ALLOYS

UDC 669.715:620.1

INFLUENCE OF CHEMICAL COMPOSITION AND STRUCTURE ON STRUCTURAL PROPERTIES OF AK4-1 ALLOY

Moscow TSVETNYYE METALLY in Russian No 8, Aug 82 pp 67-69

BICH, E. N. and KUDRYASHOV, V. G.

[Abstract] A study is made of the influence of the content of primary alloying elements at their maximum, minimum and average levels on the mechanical properties of smooth specimens of AK4-1 and specimens with circular notches under short-term static extension, and on fracture toughness under plane deformation conditions. The alloying elements are, percent: 2.0-2.6 Cu; 1.2-1.8 Mg; 0.9-1.4 Fe; 0.9-1.4 Ni. Strips 65 x 200 mm were pressed from ingots at 370-390°C and quenched in water from 525-535°C after holding for 4 hours. They were then straightened with a residual deformation of 1.5-2% and aged under laboratory conditions at 195°C for 12 hours. Specimens with notches with radii of 0.05, 0.35, 0.5 and 0.65 mm were also tested. Studies of the microstructure showed that the pressed strips were fully recrystallized. An increase in Cu, Mg, Fe and Ni content significantly increased the short term strength as a result of supersaturation of the solid solution. Variation in strength properties as a function of chemical composition was the reverse for notched specimens. Testing of specimens with varying notch sizes showed that they have no tendency toward brittle fracture, the strength of the specimen increasing with decreasing alloying element content. The variation of fracture toughness as a function of chemical composition shows that it changes like the change in specimen strength in notched specimens. An increase in Fe and Ni has a negative effect when there is a notch or crack present, decreasing fracture toughness and strength of notched specimens and increasing notch sensitivity due to the influence of large accumulations of rows of insoluble FeNiAl₉ intermetallics which act as stress concentrators. Figures 4; references 6: 5 Russian, 1 Western.
[2-6508]

HETEROGENIZING ANNEALING OF ALUMINUM ALLOY INGOTS

Ordzhonikidze IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: TSVETNAYA
METALLURGIYA in Russian No 4, Jul-Aug 82 (manuscript received 14 Aug 81)
pp 93-97

ZAKHAROV, V. V., All-Union Institute of Light Alloys

[Abstract] To optimize the structure of aluminum alloy bars it was suggested that after homogenization, heterogenizing annealing be performed, by isothermal holding at the temperature of minimal stability of the solid solution of the primary alloying elements. Heterogenizing annealing is performed by cooling the ingot at a controlled rate after homogenizing to the temperature of minimum stability of the solid solution. The cooling rate must be sufficient to prevent complete decomposition of the supersaturated solid solution, thus limiting the growth of secondary excess phase particles. Heterogenizing annealing of aluminum alloy ingots is performed after homogenization annealing to increase the deformability of alloys in pressure working by forming an optimal structure and controlling the structure and by decreasing the number of delamination type defects. Figures 2; references 9: all Russian.
[184-6508]

STRUCTURE SPECIFICS OF COMPLEXLY ALLOYED ALUMINUM

Ordzhonikidze IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: TSVETNAYA
METALLURGIYA in Russian No 4, Jul-Aug 82 (manuscript received 2 Nov 81)
pp 91-93

MIKHAYLOVA, L. V., YUSFINA, L. I. (deceased), SOLOV'YEV, V. P.,
FILIPPOV, S. F. and SHELAMOV, V. A., Moscow Institute of Steels and Alloys,
Department of Casting Process Technology

[Abstract] A study is made of the structure, phase composition and mechanical properties of type AL9 aluminum casting alloys with additional strontium, zirconium and cadmium. The microstructure and phase composition were studied on specimens which had been tensile tested in the cast state and after heat treatment. The alloying elements, while they do not change the general microstructure, do result in the appearance of new excess phases. It was found that additional alloying with strontium, zirconium and cadmium increases damping capacity, probably as a result of the excess phases liberated. Figures 2; references 3: 2 Russian, 1 Western.
[184-6508]

CHANGE IN RESISTIVITY OF AL+3.5% Cu UPON THERMAL CYCLING IN SOLIDUS-LIQUIDUS AREA

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian
No 8, Aug 82 pp 28-30

BUBENSHCHIKOV, A. S., NECHAYEV, Yu. S. and SHEKHTER, L. N.

[Abstract] Results are presented from a study of the kinetics of establishment of an equilibrium value of resistivity of the alloy Al+3.5% Cu. Strip specimens of the alloy measuring 1 x 6 x 125 mm, preliminarily annealed for several hours at 550°C to produce a large grain (up to about 1 mm) were twisted into a circle, placed concentrically in a quartz holder to prevent deformation and placed in a vertical vacuum furnace (0.133 Pa). The specimens were then heated in the furnace to 590°C and resistance measured in the solid-liquid state as the temperature in the furnace was varied through the solidus-liquidus transition point. It was found that melting centers can serve as individual dislocations, and that the activation energy of diffusion of copper in aluminum is $E = 144.4$ KJ/mol. Figures 1; references 8: 7 Russian, 1 Western.
[178-6508]

STRUCTURE OF AK4-1 ALUMINUM ALLOY SURFACED WITH COMPOSITE WIRE

Kiev AVTOMATICHESKAYA SVARKA in Russian No 8, Aug 82
(manuscript received 3 Feb 82) pp 20-23

RYABOV, V. R., RABKIN, D. M., doctor of technical sciences,
MURAVEYNIK, A. N., engineer, SHALAY, A. N., candidate of technical sciences,
VOLOSHIN, G. N., STRETOVICH, A. D., engineers, BERNADSKIY, V. N.,
candidate of technical sciences, Institute of Electric Welding,
imeni Ye. O. Paton, Ukrainian Academy of Sciences

[Abstract] This work describes structures of the hardened layer on AK4-1 alloy surfaced with nickel-containing wire under various conditions. Studies were performed with a light microscope and by microscopic x-ray spectral analysis. Microhardness was also measured. The rapid cooling of AK4-1 alloy melted by an infusible electrode leads to the formation of a fine grain structure with liberation of eutectic components on the grain boundaries. When a composite nickel-containing wire is used for surfacing, the quantity of dispersed segregation of excess phases along grain boundaries and within grains is increased. The structure of the hardened layer thus produced can be regulated by changing surfacing conditions. Figures 5; references 6: all Russian.
[186-6508]

STABILITY OF SOLID SOLUTION IN ALUMINUM ALLOYS

Moscow TSVETNYYE METALLY in Russian No 8, Aug 82 pp 69-73

DAVYDOV, V. G. and ZAKHAROV, V. V.

[Abstract] The stability of a solid solution refers to its ability to retain supersaturation under continuous cooling or isothermal holding at a temperature below the equilibrium solidus of the hardening phases. The stability is determined to a great extent by the technology of producing deformed semi-finished goods of heat treated aluminum alloys. To estimate the stability of the solid solution, isothermal and thermokinetic decomposition diagrams or C-curves were constructed and the most important factors determining stability of the solid solution analyzed. The stability of the solid solution was found to depend upon many factors determined by the chemical composition, structure, nature of interaction of alloying elements with the aluminum and previous heat treatment. In spite of the great practical importance of this characteristic, it remains largely unstudied. Study of the stability of the solid solution in aluminum alloys is a pressing practical problem for the immediate future. Figures 4; references 23: 16 Russian, 7 Western. [2-6508]

MOVEMENT OF MELT AND FORMATION OF STRUCTURE OF ALUMINUM ALLOY INGOTS

Moscow TSVETNYYE METALLY in Russian No 8, Aug 82 pp 75-77

TELESHOV, V. V. and SNETKOVA, Yu. I.

[Abstract] To confirm the existence of free growing grains in a hole in an ingot of D16 alloy cast in an electromagnetic crystallizer, the microstructure of specimens obtained by rapid crystallization of a portion of the melt taken from the hole of the crystallizing ingot was analyzed. Portions of the melt up to 5 cm³ in volume were taken by a sampler at a distance of 50 mm from the side surface of the ingot at a depth of 20 mm. The melt passed through a heated quartz tube into a copper mold with an inside diameter of 10 mm and a wall thickness of 40 mm, where it was crystallized. Sections were then made, electrically polished and anodically oxidized, then studied in polarized light. The possibility was shown of the existence of two types of structures in ingots produced by continuous casting, resulting from the intensity of movement of the melt in the crystallization hole in the ingot and differing in grain size and dimensions of dendritic cells as a function of grain growth conditions. Figures 2; references 15: all Russian. [2-6508]

ANALYSIS AND TESTING

NONDESTRUCTIVE TESTING METHODS

Moscow KOMSOMOL'SKAYA PRAVDA in Russian 29 Aug 82 p 2

[Article by L. Repin: "Tenth International Conference on Nondestructive Testing Discussed"]

[Text] Nature has blessed us with remarkable capabilities! For example, we are able to see through each other. No wonder we like to talk about this! Of course we understand quite well that we are not talking about being able to stare through someone but that we are implying something different. However, it is possible in specific cases and in a very real sense to see through things. Let us take, for example, the medusa [jellyfish]. But we can't see into the pith of a growing tree, just as we are not able to see the pearl oyster without opening the shell....

However, by the force of our intelligence we have created all kinds of instruments and devices which make it possible to look inside things which are opaque. That which is an insurmountable barrier to X-rays, which worked wonders and permitted man to look into himself, yields to the force of ultrasound or to the electromagnet.

Everything depends on a correct selection of the means. Our planet is transparent to cosmic particles which penetrate it with the ease of a bullet piercing an apple.

Several years ago in Moscow at the just-created Institute of Introscopy ("intrascopio" literally means "intravision"), the first institute in the world for the study of this problem, I was shown all sorts of wonders which at once astonish and delight. How do they properly become true wonders? For example, through a compact instrument directed at a glass beaker holding india ink I saw crystal-pure water; and also in the beaker were a five-kopeck piece and other small things, whose presence in the blackness of the ink could never have been surmised. The young science, even back then, was seeking and finding practical conclusions for the first results.

The Soviet Union now has four institutes engaged in problems of nondestructive testing, and in all industrially developed countries similar research centers exist. Here in Moscow, at an international conference on this problem, all the leading scientists of the world have gathered from 32

countries. The problem of quality control in metallurgy, steel, shipbuilding, aircraft construction, machine tools, and many other industries has become global and today is one of the most acute problems. That is why it is possible to build a unique hydraulic turbine which generates a powerful flow of energy, but how important it is to know whether or not there are micro-cracks and flaws deep inside the turbine, which after some time can result in a catastrophe!

I remember that as students at the construction institute we successfully solved similar problems, gradually increasing the load on reinforced concrete beams on a test bench up to complete breaking and observing what occurred in the beams. But the whole point is that the specimen had to break! Then in our wildest dreams we did not hope to see with our own eyes what occurs with such a beam in the already living structure, and, in perceiving gigantic forces, how in the body of the concrete the steel strands of the armature are strained....

Contemporary means of nondestructive testing (so named because nothing is destroyed) make it possible to see everything. This takes place directly, as we say, by our eyes on a screen. Even though the necessary information can not be obtained visually, the main thing is that we know what we wish to know!

We talked about possibilities and problems of the young science in the intermission between reports at the conference with its vice president, professor and director of the Institute of Introscopy, V. V. Klyuyev. He talked about the rapidly growing role of nondestructive testing equipment, and about the fact that it, in the full sense of the word, can be called the accelerator of technical progress and one of its indispensable conditions. The reports which were heard at the conference reflected the main trends outlined in this branch of science and technology in recent: the rapid introduction of electronics and computer technology and the rapidly growing role of automation in the quality control of products. In Moscow scientists talked for the first time about robot-controllers: in our time man physically is not coping with this task. The speed of the production process and the need in brief moments to make a whole series of measurements are already above our potentialities.... To make up for it, the robots can do this without the difficulties so peculiar to man.

I asked V. V. Klyuyev whether it is now possible to create any new inspection methods. He replied: "Yes, it has been possible, and they are called X-ray computer tomographs." The amazing complex created by Soviet scientists has increased sensitivity to defects by more than tenfold. I saw this complex at the exhibit accompanying the conference and asked the director of the department of the Institute of Introscopy, V. P. Kurozayev, to talk about it.

"The main advantage of computer tomography," he said, "is the fact that this method makes it possible to reveal the smallest defects which earlier had invariably escaped the eyes of the investigator, even micron cracks in metals."

Among the new trends in this field of science and technology which have recently been formed, acoustic emission must be especially singled out. The

method is interesting, first of all, in that it begins from the solution to the problem. According to the usual methods of inspection as, let us say, electromagnetic or ultrasonic, first a pulse is sent, and through its reflection from the site of the damage the necessary information was obtained. In the method of acoustic emission, signals which appear naturally when the damages occur are generated. Therefore, such a method is especially important for averting a danger. The Polish scientist, Z. Pavlovski, in telling about the method of acoustic emission, called it an integrated process which analyzes practically all components of the state of a material, such as the elastic and plastic deformation and its fatigue before failure, about which we know far from everything now. The signals, caught by sensitive instruments, tell the investigators about secrets of invisible processes and forerunners of the coming breakdown and help avert failure.

In talking about the new, still ripening methods of nondestructing testing, Prof. Pavlovski discussed acoustic and optical holography. A report was given at the conference about a fundamentally new approach to the problem. Acoustic waves can show a volumetric [three-dimensional] image of defects of the surface of different parts. Here is how potentialities of specialists, who are preserving the "health" of machines, develop....

The vigilant instruments and devices have penetrated into the most diverse spheres of our life, even, it would appear, into such a remote sphere from the field of their direct use as art. Reports at the conference discussed the use of means of nondestructive testing in inspecting of monuments of architecture, wooden sculptures and paintings. Doctor Guiseppa Nardoni, president of the Italian Association on Nondestructive Testing, told me that through these methods it was possible to save the famous bronze sculpture of Marcus Aurelius, which was created in the period of the Roman Empire. The enormous quantity of microcracks found in the sculpture was detected only because of these methods.

This is how such problems were discussed at this conference. The science is quite young, but it seems as if it has always existed, because now it is impossible to manage without it.

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COATINGS

USE OF GLOW DISCHARGE IN TECHNOLOGY OF PRODUCING PLASMA COATINGS

Kishinev ELEKTRONNAYA OBRABOTKA MATERIALOV in Russian No 4, Jul-Aug 82
(manuscript received 16 Jul 81) pp 20-23

PUSTOTINA, S. R., GLUKHOVA, L. K., NOVIKOV, N. N. and TIKHONENKO, Ye. P.,
Odessa

[Abstract] A study is made of the possibility of using a glow discharge for plasma atomization of metal ceramic coatings in the stages of surface preparation of parts of AK4 aluminum alloy in order to increase the bonding strength and for finish working of shaped protective layers. The effect of the glow discharge on the surface is related to its cleansing of various types of contaminants and oxides, heating, activation, atomization and oxidation. Ellipsometric and electronographic methods were used to study the effect of the discharge on the change in thickness and phase composition of surface layers. The influence of glow discharge treatment of the surface before atomization of metal ceramic coatings on bonding strength between coating and base was studied. Atomization involved composite metal-oxide type coatings obtained by vacuum alumination or chemical nickeliding of oxide particles. The results show that when coatings of thermally neutral powders (alumina + nickel or aluminum) were atomized, preliminary preparation by glow discharge treatment improved bonding. Figures 2; references 7; all Russian.
[1-6508]

COMPOSITE MATERIALS

UDC: 539.36.001:678.067.5

CALCULATION OF DEFORMABILITY OF THREE-DimensionALLY REINFORCED COMPOSITE WITH ELASTIC-PLASTIC MATRIX

Riga MEKHANIKA KOMPOZITNYKH MATERIALOV in Russian No 4, Jul-Aug 82
(manuscript received 3 Jul 81) pp 601-607

KREGERS, A. F. and MELBARDIS, Yu. G., Institute of Polymer Mechanics,
Latvian Academy of Sciences, Riga

[Abstract] A new calculation model of the deformation of a unidirectional material is suggested, differing in that a closed surface in the space of stresses (strains) is proposed, within which the composite follows the linear theory of elasticity, while outside it there is a nonlinear connection between ϵ and σ . Analytic forms of nonlinearity are selected using elementary functions allowing easy production of the inverse variation of the equation of state. The new calculation model allows deformation to be represented in explicit analytic form as a nonlinear function of stress and vice versa. Figures 4; references 8: 7 Russian, 1 Western.
[7-6508]

UDC: 539.4:678.067

LOCAL FRACTURES IN FIBROUS MEDIA

Riga MEKHANIKA KOMPOZITNYKH MATERIALOV in Russian No 4, Jul-Aug 82
(manuscript received 11 Jan 82) pp 618-625

VANIN, G. A., Institute of Mechanics, Ukrainian Academy of Sciences, Kiev

[Abstract] Local fractures in a fiber medium precede the development of major cracks and facilitate their more rapid growth. The initial imperfections consisting of pores and cracks are greatly elongated along fibers, a fact which is used to generate initial assumptions influencing the development of the theory of composite failure. The assumptions allow two-dimensional analysis of the stress state in a reinforced medium with cracks. Definitions

of simple and mixed fractures are introduced, corresponding to the growth of a single crack in the components of the medium, the growth of a crack in each component and at the phase division boundaries. The heterogeneous structure of the fibers is described integrally by means of a model of heterogeneous anisotropic media. Numerical analysis of the solution generated indicates the dominant contribution of the first term in the series to the elastic constants with less than 60% volumetric content of fibers. The critical stress state is calculated in the general case of longitudinal shear. In this case, the components of the Z matrix completely define the changes in mechanical characteristics of the composite medium and the onset of the critical stress state. Figures 3; references 6: all Russian, [7-6508]

UDC: 620.1:678.067

SPECIFICS OF SEMIDISK METHOD FOR STUDY OF MODERN WOUND COMPOSITES

Riga MEKHANIKA KOMPOZITNYKH MATERIALOV in Russian No 4, Jul-Aug 82
(manuscript received 29 Jun 81) pp 719-726

SHLITSA, R. P. and NOVIKOVA, Ye. A., Institute of Polymer Mechanics, Latvian Academy of Sciences, Riga; All-Union Scientific Research and Planning Institute of Artificial Fibers, Mytishchi, Moscow Oblast

[Abstract] This work studies the specifics of use and establishes limitations for application of the method of testing of circular specimens made of the most common composite materials, carbon, boron, organic material and high modulus glass reinforced plastics, were used to develop the method. Primarily thin specimens were used, since the characteristics studied were the modulus of elasticity and tensile strength. The influence of the geometric parameters of the circular specimens wrapped around the semidisks in tensile testing on the experimental results is estimated. The influence of the initial gap between the circular specimens and semidisks on test results is also estimated. The studies showed that the correct selection of geometric parameters of circular specimens, initial gap, location of deformation measurement devices, etc. allows the shortcomings of the test method to be minimized, thus increasing the accuracy of the characteristics determined, particularly the modulus of elasticity. Figures 3; references 8: 5 Russian, 3 Western, [7-6508]

INFLUENCE OF POROSITY ON GLASS REINFORCED PLASTIC STRENGTH

Riga MEKHANIKA KOMPOZITNYKH MATERIALOV in Russian No 4, Jul-Aug 82
(manuscript received 26 Oct 81) pp 729-730

MAKAROV, V. G., Kuybyshev Polytechnical Institute

[Abstract] An estimate is made of the influence of the dimensions of defects on the strength of glass reinforced plastic. A high strength epoxy composite reinforced 1:1 with fibers of nonalkaline glass based on UP-610 binder cured by diamine 304 adduct was studied. Specimens measuring 140 x 140 mm were shaped on a mandrel and hot pressed. The binder content was 27.5 to 31.6%, porosity 1.4 to 16.4%. Defects in the specimens acted as stress concentrators and weakened the composite material. Microstructural studies revealed the following: microscopic defects measuring up to 2.0 nm, combinations of intermolecular and intramolecular holes in the polymer binder; submicroscopic defects measuring up to 150 nm, cracks in the interphase layer due to shrinkage of the binder and the difference in coefficients of linear expansion and, finally, macroscopic defects including defects located near the surface of the glass fibers along the surface due to the presence of areas with zero adhesion up to 9-15 μm in diameter and defects at the points of intersection of reinforcement as large as 1.2 to 1.3 $\cdot 10^3 \mu\text{m}$. At least two methods are available to increase the mechanical strength of reinforced plastics--decreasing porosity and homogenization of the pore space. Figures 1; references 6; all Russian. [7-6508]

UDC 669-494

DEFORMATION OF FIBER COMPOSITES WITH POROUS METAL MATRIX

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 4, Jul-Aug 82
(manuscript received 23 Apr 80) pp 97-101

AREF'YEV, B. A., MALASHENKOV, S. G., USHAKOV, V. K. and MEBEL', V. S.,
Moscow

[Abstract] An attempt is made to estimate the influence of practically undeformed reinforced elements on the process of compacting a porous matrix during deformation of fiber composite materials. The process of compacting the matrix occurs not only by the effect of the tool, but also by the effect of the fibers, making the deformation which form the subject of the article. The presence of two stages of compacting of the matrix is determined and it is experimentally proven that there is a certain value of residual porosity in the matrix which achieves the optimal composite structures. Figures 3; references 6; all Russian. [185-6508]

EXPERIMENTAL STUDY OF STRESS-STRAIN STATE AND LOAD-BEARING CAPACITY OF COMPOSITE FLYWHEEL POWER STORAGE DEVICES

Kiev PROBLEMY PROCHNOSTI in Russian No 8, Aug 82 (manuscript received 19 Jan 82) pp 22-25

KOZLOV, I. A., LESHCHENKO, V. M., YUDIN, A. B., Institute of Strength Problems, Ukrainian Academy of Sciences, Kiev

[Abstract] The authors' institute in cooperation with other organizations has begun work on the creation of composite flywheel energy storage units including flat disks made of GRP by pressing layers of fabric saturated with the binder. Some of the disks are additionally wound with layers of fiber with rubber interlayers or layers of fabric saturated with binder. The deformation of the various disks when rotated at speed is compared. A thin additional ring around the rim of a disk decreases load-bearing capacity rather than improving it. Shaping of disks with tapered edges to decrease stresses or increase stress uniformity is not desirable, since it decreases the kinetic energy which can be stored to a greater extent than it decreases stresses. The most promising type of disk is that wound around the outside rim with VMPS 6-7.2 x 4 x 2-78 cored to form a strong rim. Figures 4.
[2-6508]

VARIATION IN FIBER DISTRIBUTION IN EUTECTIC Si-TaSi₂ AND Si-NbSi₂ COMPOSITES WITH CRYSTALLIZATION CONDITIONS

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 4, Jul-Aug 82 (manuscript received 2 Feb 80) pp 93-96

GRABOVETSKAYA, G. P., BUTKEVICH, L. M., MAKOGON, M. B., KAZAKOVA, N. I. and SHCHEGLIK, V. I., Tomsk

[Abstract] A study is presented of the influences of crystallization conditions (speed and method of crystallization) on regularities and distribution of fibers by dimensions and the distance between them in eutectic Si-TaSi₂ and Si-NbSi₂ composites which are of potential interest for electronics. The alloys were produced in a vacuum of 0.13 Pa in quartz crucibles using semiconductor purity silicon and electron-beam melted tantalum and niobium. The distribution of fibers was studied in sections transverse to the direction of growth by automatic quantitative microanalysis. Directed crystallization forms a directed fiber type structure. The distribution of fibers by dimensions follows the normal rule, by mean free lengths--a log-normal rule. Decreasing crystallization rate decreases the variation of distribution of strength, increasing the regularity of the composite structure. Figures 3; references 9: 3 Russian, 6 Western.
[185-6508]

EXPERIMENTAL INSTALLATION AND METHOD FOR STUDYING ACCUMULATION OF DAMAGE
IN SOFTENING COMPOSITE POLYMER MATERIALS

Kiev PROBLEMY PROCHNOSTI in Russian No 8, Aug 82
(manuscript received 2 Apr 81) pp 131-134

APINIS, R. P., SKALOZUB, S. L., Riga

[Abstract] The Institute of Polymer Mechanics, Latvian Academy of Sciences, has developed an experimental installation allowing study of changes in dynamic elasticity modulus and mechanical loss angle of rigid polymer materials during the process of fatigue failure. The device operates under resonant conditions with resonant frequency determined by the dynamic elasticity modulus of the specimen tested, its dimensions and shape. The installation allows cooling of the specimen to suppress vibration heating of the material. During a fatigue experiment, the following quantities are recorded: number of loading cycles, temperature of vibration heating, period of resonant oscillations, current in vibrator voice coil, amplitude of accelerations of additional mass. Experiments on the dynamic fatigue of glass-reinforced textolite show that the increase in temperature can be considered linear with time. The accumulation of damage in a specimen is judged from the change in resonant frequency as the test progresses. Figures 3; references 5: all Russian.
[2-6508]

UDC: 678.5:539.371:624.074.4

DESIGN OF CYLINDRICAL TENSION MEMBERS OF COMPOSITES TO BE USED IN MANIPULATORS
FOR STRENGTH

Riga MEKHANIKA KOMPOZITNYKH MATERIALOV in Russian No 4, Jul-Aug 82
(manuscript received 18 Sep 81) pp 734-737

ZAYTSEV, G. P., KOPYL, N. I., VETKINA, L. V., ALYAMOVSKIY, A. A. and BOGONENKOV, M. I., K. E. Tsiolkovskiy Institute of Aviation Technology, Moscow

[Abstract] The purpose of this work was to determine the angle of reinforcement α and geometric characteristics of composite cylindrical sections with limitations on the permissible twisting angle and flexure angle considering the assigned outside diameter, transverse force and torque. The results of calculation of elasticity characteristics of the composites were used to construct graphs of the variation of P'_1 and G' as a function of angle of reinforcement α . A method was used to calculate the geometric characteristics of the cylindrical sections of a manipulator with: outside diameter 280 mm, length of "shoulder" and "elbow" sections 7.0 and 7.5 m. With a torque of

800 N·m, the twist angle of the "shoulder" section must remain not over 0.5°; at 280 N·m the angle of rotation of the "elbow" section should not exceed 0.35°; the maximum bending of the "shoulder" section under a transverse force of 250 N should not exceed 2 cm; the flexure of the "elbow" section under a force of 75 N must not exceed 1 cm; the mass of the "shoulder" section should not exceed 20 kg, of the "elbow" section - 14 kg. The data on design of manipulator sections indicate that the use of composites assures higher rigidity and strength in combination with low mass of the structure and ease of manufacture, as well as the use of the optimal reinforced material. The manipulator discussed in the article is a remote manipulator system for the space shuttle orbiter.
[7-6508]

EXTRACTION AND REFINING

UDC: 669.64

NEW PROCESSES AND APPARATUS FOR TIN REFINING AND PROSPECTS FOR EXPANSION OF THEIR USE IN NONFERROUS METALLURGY

Moscow TSVETNYYE METALLY in Russian No 9, Sep 82 pp 11-12

GROZDEV, S. S.

[Abstract] A basically new technology for purification of tin and tin alloys has been developed. Various design versions of purification apparatus based on centrifugal filtration have been developed. Development has resulted in the production of an industrial model automatic centrifuge. The apparatus is airtight and operates automatically under the control of a program punched in a control panel. Following industrial testing the method and apparatus of centrifugal filtration have been introduced at the Novosibirsk Tin Combine for purification of tin, removing iron and arsenic, and at "Ryaztsvetmet" Plant for purification of tin-lead alloys, removing copper. The continuous process of tin purification has allowed refining of tin with a high content of impurities to be performed at reduced cost, significantly changing the technological process of tin production. The new process has decreased tin losses to 0.52%, increased the quality of the product produced and increased the extraction of accompanying metals such as bismuth, antimony, copper, lead and indium. A lead plant has tested the process for bismuth removal from lead using the same centrifuge with a 150 ton ladle. The equipment can also be used for removal of silver from lead and iron from zinc and aluminum. The PAFVS 650-9U centrifuge is very successful in all these processes.
[9-6508]

UDC: 622.7:621.9.048.6

BENEFICIATION OF RARE METAL ORES WITH ULTRASOUND

Moscow TSVETNYYE METALLY in Russian No 9, Sep 82 pp 102-106

ZUBKOV, A. A. and BELOV, B. G.

[Abstract] Experimental studies on the influence of ultrasound on processes of beneficiation of rare metal ores was performed using an installation

consisting of high frequency generators and convertors. The intensity of the sound was determined by a calorimetric method using an acoustical watt meter. Flotation experiments were performed in an FM-2 flotation machine producing coarse concentrate and tailings. To intensify flotation beneficiation, the slurry was treated with ultrasound before flotation reagents were added. The extraction of BeO into the concentrate increases with increasing ultrasound intensity and time of exposure up to a certain point, after which it decreases for all frequencies tested. The use of crossed ultrasonic fields at different frequencies increased the extraction of lithium in the concentrate from 1.28 to 1.75% while decreasing the consumption of sodium oleate by 20% and reducing the contact time of the slurry with caustic soda by a factor of 25. Best results were achieved with oscillation frequencies of about 1 MHz and higher. Results were improved by combining processes of ultrasound treatment and flotation in a single flotation chamber. Figures 2; references 8: all Russian,
[9-6508]

UDC 621.762.01

CONDITIONS OF APPEARANCE OF SUPERPLASTICITY OF SAS-1 ALLOY GRANULE BARS

Ordzhonikidze IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: TSVETNAYA METALLURGIYA in Russian No 4, Jul-Aug 82 (manuscript received 12 Nov 81) pp 87-90

SHEPEL'SKIY, N. V., GRISHCHENKO, N. A., ORELKINA, T. A., BELOKOPYTOV, V. I., Krasnoyarsk Institute of Nonferrous Metals, Department of Pressure Working of Metals

[Abstract] The authors seek conditions of increased deformability of bars made of granules of SAS-1 alloy (25-30% Si, 5-7% Ni, remainder Al) by determining the interval of the superplastic state of the material. The bars for the study were obtained by pressing briquets with a reduction factor of 37. The briquets were heated for one-half hour to the pressing temperature of 450°C and specimens prepared from them. Each specimen of a pair of different diameters was tested under identical conditions. It is concluded that the alloy has elevated plasticity of 485 to 525°C, deformation rates $5 \cdot 10^{-4}$ to $3 \cdot 10^{-3} \text{ s}^{-1}$ with low shear resistance and high speed sensitivity, allowing superplastic deformation. Figures 3; references 6; all Russian.
[184-6508]

UDC 669.018

STRUCTURAL-MORPHOLOGIC STUDY OF TITANIUM DIBORIDE UPON OXIDATION IN VARIOUS MEDIA. II. OXIDATION OF TITANIUM BORIDE IN WATER PLUS WATER VAPOR

Kiev POROSHKOVAYA METALLURGIYA in Russian No 8, Aug 82
(manuscript received 24 Feb 82) pp 64-67

PILYANKEVICH, A. N. and PAPYAN, S. V., Institute of Materials Science Problems, Ukrainian Academy of Sciences

[Abstract] A study is made of the oxidation of titanium diboride in water vapor by electron microscope, petrographic and x-ray structural methods.

Specimens were oxidized by boiling in tap water for up to 150 hours. Photomicrographs of the specimens are presented. It is established for the first time that titanium diboride is oxidized at temperatures of not over 100°C. The degree of oxidation can be determined only by electron microscopy, partially by petrography. Oxidation is more rapid in boiling water than in steam. Figures 4; references: 1 Russian.
[183-6508]

UDC 666.233

INTERACTION OF SUPERHARD POWDERS WITH GASES UPON HIGH TEMPERATURE IMPACT COMPRESSION

Kiev POROSHKOVAYA METALLURGIYA in Russian No 8, Aug 82
(manuscript received 19 Jun 81) pp 85-89

SAVVAKIN, G. I. and FENOCHKA, B. V., Institute of Material Science Problems, Ukrainian Academy of Sciences

[Abstract] A study is made of the specifics of the interaction of gases with superhard material powders crystallizing upon high temperature impact compression as a function of crystallization conditions, which causes various degrees of instability in the initial phase. Mass spectrometry was used to study the products of interaction of diamond and diamond-like boron nitride phases with hydrogen and other reducing gases. The studies show that hydrogen is liberated by a dual mechanism. It is usually the product of dissociation of hydrocarbons in the gas phase at 150-200°C. If no hydrocarbons are present, significant quantities of hydrogen appear in the gas phase at about 600°C, indicating that hydrogen is present in the specimens in both adsorbed form and as organic impurities, or possibly in chemical bonds with the elements of the specimen studied, Figures 1; references 12: all Russian.
[183-6508]

UDC 621.1762

EXPLOSION PROTECTION PROPERTIES OF SINTERED TITANIUM POWDER FLAME BARRIER ELEMENTS

Kiev POROSHKOVAYA METALLURGIYA in Russian No 8, Aug 82
(manuscript received 14 Feb 81) pp 102-104

GUTMAN, F. G., KORNIYENKO, P. A., PUGIN, V. S., BOYKOV, N. A. and PANASYUK, A. V., Institute of Material Science Problems, Ukrainian Academy of Sciences

[Abstract] A study was made of the variation in critical damping pressure as a function of pore size in porous titanium, as well as the variation in pore

size and gas permeability with repeated flame damping of rapidly burning gas mixtures. Studies were performed on specimens of cup shape (25 mm in diameter and height, 2.5 mm wall thickness). It was determined that for porous titanium the critical damping pressure is inversely proportional to the square of the maximum pore size. Pore sizes and permeability change upon repeated exposure to flame. This means that flame damping structures of this type must be periodically replaced after a certain number of cycles. The number of cycles of use depends on the sintering temperature, initial pore diameter and flame characteristics. Figures 2; references 3: all Russian.
[183-6508]

STEELS

UDC 531.44:539.621:548.73

DIFFRACTION LINE WIDTH AS CRITERION OF FORMATION OF PROTECTIVE STRUCTURE UPON FRICTION OF CARBON STEELS IN A VACUUM

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 4, Jul-Aug 82
(manuscript received 10 Mar 80) pp 88-92

MAR'YAKHINA, Ye. I., VOSKOBOYNIKOV, D. B., Khar'kov

[Abstract] It is suggested that the diffraction line width be used as a dynamic criterion of the existence of a protective structure on a friction surface, since studies of various steels performed by the authors have shown that the diffraction line width of the α -phase is identical for all steels and is much greater than the width obtained after severe plastic deformation, and that it is greater than the width of the line for hardened steel. Tests were performed in a special vacuum chamber at 10^{-3} Pa on the lateral surfaces of rolls made of low tempered case hardened type 12KhN3A steel and normalized type 45 steel in friction with hardened ShKh-15 steel. The protective structure was found to have an anomalously high $(110)_{\alpha}$ line width of the α -phase, significantly greater than the values obtained on hardening of the steels. The line width can indeed serve as a dynamic indicator of the existence on a surface of protective structure sectors. Figures 3; references 8; all Russian.
[185-6508]

UDC 620.18;669.14;621.787.044.2

STRUCTURE AND HARDNESS OF TYPE 45 STEEL AFTER EXPOSURE TO CO₂ LASER RADIATION

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 9, Sep 82 pp 29-31

GRIGOR'YANTS, A. G., SAFONOV, A. N., TARASENKO, V. M., MAREYEV, N. Yu., Higher Technical School, imeni N. E. Bauman, Moscow; Scientific Research Center for Casting Techniques, USSR Academy of Sciences

[Abstract] Results are presented from studies of the structure and properties of type 45 steel after hardening laser treatment using an LT1-2 CO₂ laser.

Specimens of type 45 steel measuring 10 x 10 x 50 mm were hardened in water from 850°C, low tempered at 200°C, 40 minutes, covered with carbon black to increase light absorption and exposed to a 3.1 KW laser beam, radiation spot 2 mm, focal length of focusing lens 200 mm. After treatment, microhardness of the surface was measured, then metallographic sections were prepared to study the microstructure, determine dimensions of the hardened zone and measure microhardness through its thickness. Photomicrographs show cross-sections of the hardened zone. The change in microhardness over the surface of the specimen was found to be quite non-uniform, particularly after laser working with overlapping hardened bands due to the formation of tempered zones. Figures 2; references 6: 5 Russian, 1 Western.
[5-6508]

UDC 620.187:669.14.018.254

STRUCTURAL CHANGES IN STEEL UPON CYCLICAL HETEROGENEOUS HEAT TREATMENT

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 9, Sep 82 pp 2-4

IZOTOV, V. I., KOTEL'NIKOV, G. A., KULINICHEV, G. P., MIFTAKHOV, R. G. and TETYUYEVA, T. V., Central Scientific Research Institute of Ferrous Metallurgy imeni I. P. Bardin, Kuybyshev Polytechnical Institute

[Abstract] A study was made of the influence of cyclical high temperature plasma effects on the properties of specimens of 4Kh4VMFS steel (0.38-0.42% C; 0.2-0.5% Mn; 0.6-0.9% Si; 3.5-4.1% Cr; 0.9-1.1% W; 0.7-0.9% V; 1.2-1.3% Mo). Plate specimens measuring 2 x 12 x 80 mm were hardened in oil from 1050-1070°C and tempered at 620-640°C. Then individual surface sections of the specimens were cyclically heated by a high temperature plasma. The maximum surface temperature was $1010 \pm 40^\circ\text{C}$, the minimum $580 \pm 30^\circ\text{C}$. The heating time to the maximum temperature was 2 sec, cooling time to the minimum temperature not over 4 sec. After as many as 1000 heating cycles with cooling to room temperature, the specimens were tested through the cross-section by duratometry and x-ray methods. The structural state was evaluated by light and electron microscopy. Intensive heat cycling was found to cause irreversible structural transformations, leading to the formation of a multi-layer zone on the surface of the specimen. In spite of the dynamic nature of the heat applications, the accumulation of irreversible changes was qualitatively determined by the thermodynamic equilibrium states. The results indicate the need for further studies of the basic regularities and particularly functional interactions of irreversible structural changes and mechanisms of accumulation of microscopic and macroscopic damage in these sections, leading to failure of the actual structures under operating conditions. Figures 1; references 10: 8 Russian, 2 Western.
[5-6508]

STRUCTURE AND PROPERTIES OF LOW-PEARLITE STEEL WITH VARYING TITANIUM CONTENT

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 8,
Aug 82 pp 58-59

NASIBOV, A. G., SVESHNIKOVA, G. A., GULEY, G. G., GUSEYNOV, R. K.,
LAMINTSEV, V. G., Central Scientific Research Institute of Ferrous Metallurgy
imeni I. P. Bardin, Asian Polytechnical Institute imeni Ch. Il'dryma, USSR
Ministry of Ferrous Metallurgy

[Abstract] A study was made of the influence of titanium content on the structure, impact toughness and brittle fracture tendency of commercial low-pearlite type 10G2F steel sheets produced in converter furnaces and treated with synthetic slags and silicocalcium, and also by blowing through argon, and poured in a continuous casting machine. The chemical composition of the experimental steel (8 melts) was as follows: 0.09-0.10% C; 1.55-1.75% Mn; 0.23-0.32% Si; 0.095-0.11% V; 0.005-0.006% S; 0.017-0.021% P and 0.010-0.045% Ti (at intervals of 0.005%). The carbon equivalent was 0.037-0.040%. Varying the content of titanium from 0.015 to 0.045% had practically no influence on mechanical properties, including resistance to brittle and viscous fracture at low temperatures. Its primary influence was a difference in the tendency of the melts toward austenite grain growth. Figures 2.
[178-6508]

COOLING RATE AND MICROSTRUCTURE OF SURFACE LAYERS OF 5KhNM STEEL TREATED BY ELECTROEROSION

Kishinev ELEKTRONNAYA OBRABOTKA MATERIALOV in Russian No 4, Jul-Aug 82
(manuscript received 12 Oct 81) pp 11-13

FOTEYEV, N. K., PLOSHKIN, V. V., LYAKISHEV, V. A., SHIROKOV, S. V.,
Moscow

[Abstract] During electroerosion, metal is removed by the effect of energy pulses on the surface of the blank being worked, allowing some analogy to be drawn with surface working by pulsed laser radiation. Electric erosion of 5KhNM stamping steel was performed in kerosene with pulse length $6-14 \cdot 10^{-5}$ s, energy $3 \cdot 10^5$ W/cm². Metallographic studies showed that electric erosion working caused melting of the surface, with the formation of a surface layer upon crystallization with microstructure altered in comparison to the initial structure. Microscopic x-ray spectral analysis showed that there were no concentration heterogeneities of alloying elements in the electrically eroded zone. Redistribution of alloying elements between the surface layer and initial material was also found, indicating that the dispersion of the carbide phase is great, with its particles not over 1 micrometer in size. Figures 2; references 4: all Russian.
[1-6508]

DEFORMATION OF STEELS DURING LASER HARDENING

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 9,
Sep 82 pp 38-41

GONCHARENKO, V. P., VORONOV, I. N., VELIKIKH, V. S. and KARTAVTSEV, V. S.

[Abstract] Results are presented from a study of the influence of pulsed laser hardening on "KVANT-16" and "KVANT-18" installations on the deformation of carbon, structural and tool steel specimens. Deformation was determined using flat prismatic specimens of steels types U8, 45 and 65G with various initial hardnesses and structures after preliminary normalization and after hardening and tempering at 350-530°C, and also plates of 65G steel 0.2 to 1 mm thick. It was found that laser hardening may produce buckling of structural and tool steels, caused by thermal expansion of the surface layer, the formation of martensite in this layer, residual stresses and structural heterogeneities through the cross section. Buckling can be reduced significantly by varying the sequence of spots where the laser beam is applied. Figures 5; references 3: all Russian.
[5-6508]

UDC 669.14.018.25:621.7.044

METHOD OF DETERMINING OPTIMAL LASER HARDENING CONDITIONS FOR STEELS AND QUALITY MONITORING

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 9,
Sep 82 pp 36-38

BRATIVNIK, Ye. V., VELIKIKH, V. S., GONCHARENKO, V. P., KARTAVTSEV, V. S. and TARARAKSINA, O. G.

[Abstract] A standard technology for laser hardening has been developed allowing hardening of practically all steels used in tool making. Hardening can be performed in air or argon. The method involves 50% overlap of laser exposure zones, producing the most uniform possible hardened layer. Before laser treatment, tool parts must be mechanically worked to the proper size and shape and finish sharpened, then cleaned (removing oil and oxide films, scale, traces of corrosion, etc.). There must not be cracks, burrs or burned spots. Before laser working the tool and dies are rubbed with ethyl alcohol. The procedure for determining laser spot size and other characteristics is briefly outlined. Laser working may cause warping of the tools due to thermal expansion of the surface layer, formation of martensite in the layer, residual stresses and heterogeneity of structure through the cross-section. Figures 5; references 3: all Russian.
[5-6508]

PROBLEM OF THERMAL STABILITY OF R6M5 STEEL AFTER LASER TREATMENT

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 9,
Sep 82 pp 33-36

BURAKOV, V. A., BROBER, G. I. and BURAKOVA, N. M., Rostov-on-Don Institute of
Agricultural Machine Building, Scientific Research Institute of Automobile,
Tractor and Agricultural Machinery Technology

[Abstract] A study is made of the structure and properties of R6M5 steel after hardening treatment by laser. The steel was initially heat treated by hardening and triple tempering according to the usual method. The irradiated surface layer has a heterogeneous structure with at least three characteristic zones seen after etching: light zones with slightly etched structure and elevated hardness, subdivided into two types: those in which boundaries of former austenite grains are seen with maximum hardness, and zones with needle structure and somewhat lower hardness. There are also dark zones, more strongly etched with predominance of austenitic components and the lowest hardness. These dark zones are usually located at the center of a laser spot, and result from microfusion of the surface. Laser working results in an increase in heat resistance of high speed steel and can be effectively used to increase wear resistance of metal working tools, increasing operating life by a factor of 2-3 for GPZ23 cutting tools.

Figures 4; references 3: all Russian.

[5-6508]

TITANIUM

UDC 669.295

INFLUENCE OF SPONGE TITANIUM STRUCTURAL CHARACTERISTICS ON QUALITY

Ordzhonikidze IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: TSVETNAYA METALLURGIYA in Russian No 4, Jul-Aug 82 (manuscript received 26 Nov 81) pp 111-114

ALEKSANDROVSKIY, S. V., CHEREPANOVA, Ye. I., TITARENKO, A. I., KUZ'MENKO, A. S. and GOLIKOV, V. V., Leningrad Mining Institute, Department of Light and Rare Metal Metallurgy

[Abstract] Local samples of sponge titanium obtained in industrial equipment were used to determine the correlation between the structure of sponge titanium and its quality. As total porosity increases the hardness of the sponge increases, primarily due to a decrease in large pore volume. The study of the microstructure showed that the dimensions of individual metal grains decrease with an increase in hardness. Increasing porosity also increases nitrogen content. To produce high quality metal the sponge titanium treated should have the optimal pore structure, which can be regulated by controlling the feed of titanium tetrachloride, process temperature and magnesium chloride pouring conditions. Figures 2; references 3: all Russian. [184-6508]

UDC 669.2

HYDROMETALLURGICAL PURIFICATION OF MAGNESIUM-THERMAL SPONGE TITANIUM

Ordzhonikidze IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: TSVETNAYA METALLURGIYA in Russian No 4, Jul-Aug 82 (manuscript received 14 Jul 81) pp 54-58

SANDLER, R. A., VOROTINOVA, B. G., ZAKHAREVICH, A. A., LIKHTERMAN, V. A. and FIRSOV, A. Yu., Leningrad Mining Institute, Department of Light and Rare Metal Metallurgy

[Abstract] Purification of magnesium-thermal sponge titanium by leaching to produce a good quality product is a much more difficult task than purification by electrolytic refining. To increase the quality of sponge titanium

purified by the hydrometallurgical method the technology of metallothermic production must provide for the production of sponge titanium with sufficient porosity but minimum possible specific surface. Decreasing process temperature to 0-2°C can significantly reduce the contamination of titanium by oxygen and hydrogen. The presence of lower chlorides of titanium does not significantly contaminate the sponge titanium with oxygen. As porosity increases, the degree of dissolution of oxides present in the magnesium chloride increases. Figures 1; references 6; all Russian.
[184-6508]

UDC 539.434;620.251

LOW-CYCLE FATIGUE OF TITANIUM ALLOYS PROMISING FOR USE IN CRYOGENERATORS

Kiev PROBLEMY PROCHNOSTI in Russian No 8, Aug 82
(manuscript received 19 Jan 82) pp 10-15

STRIZHALO, V. A., ZINCHENKO, A. I., CHERNYY, A. A., GREKOV, N. A.,
ARKOVENKO, G. I., Institute of Strength Problems, Ukrainian Academy of
Sciences, Kiev, Leningrad

[Abstract] Two pseudo-alpha alloys of titanium--PT3V and 19--are being considered as prospective rotor alloys in construction of cryogenic equipment, to replace chrome-nickel steels and alloys based on copper and aluminum. The results of studies of these two alloys for low-cycle fatigue resistance are presented in this work. The loading conditions and test temperatures were selected considering the operating conditions of cryogenerator rotors. The load was varied in a pulsating cycle at relatively low frequency and constant temperatures of 293, 77 and 4.2°K, in liquid nitrogen and helium at the lower two temperatures. The results of studies of the low cycle fatigue strength of the two alloys are compared with comparable data for VT5-1 and AT2-2 alloys, which have been used in cryogenic equipment in recent years. The rate of strength increase with decreasing temperature is practically the same for all titanium alloys, but the rate of change of ductility differs significantly. Throughout the entire low-cycle fatigue strength area studied, the cyclical strength of PT3V alloy increases with decreasing temperature clear down to 4.2°K. Stress relaxation should be more intensive in alloys with lower yield point, greater ductility and lower cyclical creep resistance, giving the advantage to type 19 alloy over the other titanium alloys. Figures 5; references 3: all Russian.
[2-6508]

WELDING

UDC; 621.791.052:620.18

EMBRITTLMENT OF WELDED JOINTS IN AUSTENITIC STEELS UPON REPEATED HEATING AND DEFORMATION

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 9, Sep 82 pp 2-4

PROKHOROV, N. N., doctor of technical sciences, IVCHENKO, P. S., engineer, LAZ'KO, V. Ye., candidate of technical sciences and YEFIMOVA, I. M., engineer

[Abstract] Results are presented from studies of the degree of embrittlement of austenitic steels of various strength levels when reheated after welding. The studies were performed on steels type 12Kh18N10T, 50G25Kh2S2F2Yu2NBM and 90G28Yu9MVB - chrome nickel and high manganese steels with carbide and intermetallide hardening. The tests were performed on an installation allowing thermal and mechanical stresses to be varied widely. The specimens were flexed around their centers in a deformation cycle set by the shape of a cam in the electromechanical drive. The steels were tested after deformation aging at room temperature. The specimens were then flexed in the direction opposite the direction of deformation during aging. It was found that type 90G28Yu9MVB steel has less tendency toward embrittlement upon reheating and deformation during welding and should therefore be used for the manufacturing of welding structures. The properties of 90G28Yu9MVB steel can be improved by the use of low tempering at 200°C, 2 hours. Figures 4; references 4; all Russian. [8-6508]

UDC; 621.791.052:520.192.47

INFLUENCE OF HYDROGEN DISSOLVED IN ACTIVE METALS ON BUBBLE DEVELOPMENT UPON FUSION WELDING

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 9, Sep 82 pp 6-8

REDCHITS, V. V., candidate of technical sciences

[Abstract] A physical-mathematical model of the kinetics of bubble growth upon welding of commercial semifinished goods is suggested for analytic

solution of the problem of convective diffusion development of bubbles in the welding bath. The hydrodynamic situation in the welding bath consists of turbulent flow of metal in the head and laminar flow in the tail. The total flow of hydrogen to a bubble consists of thermal diffusion, directed perpendicularly to the surface of the melt and caused by floating of the bubbles and convection of the bath metal. There is a diffusion boundary layer around each gas bubble. The concentration of the gas in the volume of the bath during welding is maintained quasi-steady. The main mass of metal in the welding bath is isothermal due to convection with the exception of the boundary layer, in which the temperature varies. The welding of titanium is used as an example to determine the significance of dissolved hydrogen in the development of bubbles during welding of hydride forming metals. Convective flows are found to have a greater influence than thermal diffusion flows on bubble development. The most dangerous source of bubble development is gaseous substances adsorbed onto the ends of the edges to be welded together. The hydrogen contained in the metal facilitates additional development of bubbles already present in the volume. Figures 6; references 9: all Russian. [8-6508]

UDC: 621.791.01:548.5

INFLUENCE OF METALLURGICAL AND TECHNOLOGICAL FACTORS ON POROSITY OF WELDED JOINTS IN 1420 ALLOY

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 9, Sep 82 pp 21-22

RYAZANTSEV, V. I., candidate of technical sciences, FEDOSEYEV, V. A., engineer, GRININ, V. V., candidate of technical sciences and KIRYSHEVA, T. N., engineer

[Abstract] Results are presented from studies of the influence of various methods of welding, protective gases, fluxes, welding wires and the chemical composition of the base metal itself on pore formation during welding. The methods of argon arc welding of the butt joints with tungsten electrodes included manual, automatic, automatic pulsed, automatic with scanning of electrode, automatic with electromagnetic displacement and automatic in helium. It is shown that changing the technology has little influence on the number and size of pores in the welded seams. Changing the chemical composition of the base metal and welding wire also fails to achieve pore-free welded joints. Rewelding from the weld root side produces pore-free welded joints by improving degassing conditions. References 6: all Russian. [8-6508]

DETERMINATION OF OPTIMAL DIFFUSION WELDING CONDITIONS FOR TsTS-19
PIEZOCERAMIC AND AMg6 ALUMINUM ALLOY

Kiev AVTOMATICHESKAYA SVARKA in Russian No 8, Aug 82
(manuscript received 9 Feb 82) 24-26

KAZAKOV, N. F., doctor of technical sciences, Moscow Institute of Aviation Technology, NOVIKOV, V. G., candidate of technical sciences, YEKIMOV, A. I., engineer, KRAVCHENKO, V. Ye., candidate of technical sciences, Plant and School for Advanced Technical Training, Affiliate of Krasnoyarsk Polytechnical Institute

[Abstract] A study is made of the influence of diffusion welding parameters such as temperature, pressure, time of isothermal holding, heating and cooling rates on the properties of joints made between type TsTS piezoceramic and AMg6 aluminum alloy. Specimens 35 mm in diameter and 3-5 mm thick were welded, then the welded zone structure was studied on a microscope and its phase composition by x-ray structural analysis. The strength of the joints was determined by shear testing. The area of optimal conditions can be determined by the use of a nomogram presented in the article. This range of conditions allows achievement of a maximum joint strength of over 2.5 MPa in shear. These joints can operate for long periods of time under vibration loading with cyclical thermal shock in the range of -196 to +100°C. [186-6508]

UDC 621.791.4:539.378.3:669.295

SPECIFICS OF DIFFUSION WELDING OF TITANIUM NEAR THE POLYMORPHOUS
TRANSFORMATION TEMPERATURE

Kiev AVTOMATICHESKAYA SVARKA in Russian No 8, Aug 82
(manuscript received 9 Feb 80) pp 27-29

GOSTOMEL'SKIY, V. S., candidate of technical sciences, KARAKOZOV, E. S., doctor of technical sciences, TERNOVSKIY, A. P., candidate of technical sciences, Moscow Evening Metallurgical Institute

[Abstract] An equation is derived for the effect of structural stresses developing during polymorphous conversion, which act as if an additional surrounding compressive or tensile load were applied during diffusion welding. It is found that these structural stresses significantly exceed the stresses used in diffusion welding. Experimental testing of the correctness of this assumption was performed on cylindrical specimens of technically pure titanium with initial fine grain structure. The studies indicate that polymorphous conversions have a significant influence on the kinetics of formation of joints during diffusion welding, particularly the formation of a contact interface. Figures 4; references 7; all Russian. [186-6508]

CONDITIONS OF FORMATION OF CROSS-SHAPED JOINTS IN TITANIUM ALLOY WIRES BY DIFFUSION WELDING

Kiev AVTOMATICHESKAYA SVARKA in Russian No 8, Aug 82
(manuscript received 28 Dec 81, in final form 31 Mar 82) pp 30-32

TRET'YAKOV, A. F., LOZEYEV, G. Ye., candidates of technical sciences, and
POLUSHKIN, G. P., ZUDOV, N. I., engineers, Moscow

[Abstract] The purpose of this work was to establish the influence of chemical etching on the quality of cross-shaped joints in wires. Studies were performed on specimens imitating individual wire joints in VT1-00 and VT2 alloys 1.0 and 5 mm in diameter as delivered. Welding was performed with induction heating, residual pressure in the chamber $1 \cdot 10^{-2}$ to $6 \cdot 10^{-2}$ Pa. Welding time was determined from the kinematic curves of strength increase in the joint to be 15 minutes. An equation is presented for the relative compression of the wires during welding. The optimal welding process parameters were found by mathematical experimental planning, using the force required to separate the wires as the optimization parameter. It is found that chemical etching of the wires increases welded joint quality. Strength uniformity of the joints is achieved at temperatures above the polymorphous conversion point (950°C) with deformation 0.15, welding time 15 minutes, after etching of the wires in a solution of 15% HNO_3 +2% HF for 30 seconds.
[186-6508]

UDC 621.791.052:620.17:669.715:[621.791.052:539.38+66.085.3]

CHANGE IN MECHANICAL PROPERTIES OF 1201 WELDABLE ALLOY UNDER INFLUENCE OF DEFORMATION AND GAMMA-IRRADIATION

Kiev AVTOMATICHESKAYA SVARKA in Russian No 7, Jul 82
(manuscript received 8 Jan 82) pp 6-8

DROBYAZIN, V. N., candidate of technical sciences, POLOVNEVA, S. P.,
PODZIREY, Yu. S., engineers, Institute of Nuclear Research, Ukrainian
Academy of Sciences

[Abstract] The purpose of this work was to study the effects of gamma-quanta irradiation and deformation on the mechanical properties of type 1201 steel after aging. Sheets 10 mm thick were used, with tensile-testing specimens 3 mm in diameter cut from the sheets, hardened from 535°C in water, following 3-4 hours holding at the hardening temperature. Specimens were stretched uniaxially, then irradiated in a cobalt installation with a gamma-quantum energy of 1.25 MeV, $5 \cdot 10^3$ R/s in various doses. Specimens were aged in a furnace at 175°C for 16 hours, and control specimens were subjected to the same treatment except irradiation. Welded specimens of 1201 alloy produced by argon-arc welding were also tested. It was found that uniaxial

deformation at 3-5% after hardening before artificial aging increases strength by 20-30% and ductility by a factor of 1.5-2 in comparison to specimens simply hardened and artificially aged. Gamma irradiation between deformation and artificial aging expands the range of optimal deformation and additionally increases strength. The increase in strength and particularly ductility upon uniaxial deformation results from supersaturation of the metal with point defects facilitating diffusion and heterogeneous formation of θ' -phase centers at dislocations during subsequent artificial aging. Irradiation increases the concentration of θ' -phase. Hardening, uniaxial extension, gamma irradiation and artificial aging can increase the short term strength of 1201 alloy by 10% while retaining high ductility. Figures 2; references 9: 5 Russian, 4 Western.
[179-6508]

UDC 621.791.7.052:620.163.4:669.715

FRACTURE TOUGHNESS OF ALUMINUM ALLOY WELDED JOINTS

Kiev AVTOMATICHESKAYA SVARKA in Russian No 7, Jul 82
(manuscript received 29 Sep 81; in final form 7 Jan 82) pp 9-13

MIRONENKO, V. N., candidate of technical sciences, and KURTASOVA, L. A., engineer, Moscow Oblast

[Abstract] An analysis is presented of factors influencing the fracture toughness of welded joints in high strength aluminum alloys. Studies were performed on joints in sheets of aluminum-zinc-magnesium, aluminum-zinc-magnesium-copper, aluminum-copper, aluminum-copper-magnesium, aluminum-copper-magnesium-silicon, and aluminum-magnesium-lithium alloys produced by argon-arc and electron-beam welding. Thermal or thermomechanical treatment of the base metal and welded joints was performed as recommended in the literature. The phenomenological method of determining the specific fracture work upon static bending of specimens with varying radius at the notch tip was used to estimate fracture toughness. The work of fracture varied over a broad range as a function of alloy type, welding material, heat treatment and point of application of the notch. The most brittle location is usually the zone of fusion, which is affected less by the welding wire material used than by the joint itself. Increasing the total content of Zn+Mg and decreasing the Zn/Mg ratio decrease the value of a_p of the welded joint. Additional alloying of binary and ternary alloys with copper, magnesium and silicon, separately or in various combinations, as well as the use of complexes of additives decrease fracture toughness. Fracture toughness can be increased by decreasing the energy per unit length during argon-arc welding or by the use of pulsed current in welding. Electron beam welding provides viscous fracture of specimens up to 16 mm thick at test temperatures down to -196°C for alloys 1201, 1915 and 1911, down to -70°C for the alloy 01420 (aluminum-magnesium-lithium). Figures 2; references 10: all Russian.
[179-6508]

INFLUENCE OF SMALL QUANTITIES OF TITANIUM IN WELDING OF 08Kh18N10 STEEL ON PROPERTIES OF SEAMS AFTER AGING IN HELIUM AND AIR

Kiev AVTOMATICHESKAYA SVARKA in Russian No 7, Jul 82
(manuscript received 15 Dec 81) pp 16-18

NOVOZHILOV, N. M., doctor of technical sciences, KUZNETSOV, Ye. V., candidate of technical sciences, TKACHENKO, Yu. S. and FILATOV, V. M., engineers, and RYABCHENKOV, A. V., doctor of chemical sciences, Scientific-Production Union, Central Scientific Research Institute for Heavy Machine Building

[Abstract] The task of this work was to estimate the influence of small quantities of titanium on the welding of 08Kh19N10 steel, on the process of oxidation and the strength of joints working in helium and in air at high temperatures. Seams of variable composition were studied, allowing rapid and accurate estimation of the influence of the elements studied on the service and technological properties of the alloys and their welded joints. The basic metal specimens were plates measuring 350 x 80 x 10 mm of 08Kh18N10 steel subjected to austenitization at 1050°C, 30 minutes, cooling in air. The results recorded after holding in helium of specimens with not over 0.06% Ti differed little from those obtained upon testing in air. Specimens were covered with a thin layer of oxides. The studies indicated that slight changes in the content of titanium between 0.016 and 0.29% in the seam metal significantly affected strength properties after holding at 700°C for 1000 hours in air and helium. The decrease in high temperature resistance of the metal as the quantity of titanium is increased over 0.12% results in a decrease in strength properties after holding at 700°C in both air and helium. However, after aging in air this decrease is greater, corresponding to the greater deterioration and characteristics of heat resistance of the metal of the welded seam. Figures 5; references 2: both Russian.
[179-6508]

UDC 621.791.25

CHANGE IN METAL AND ALLOY STRUCTURES AFTER EXPOSURE TO INTENSE NANOSECOND ELECTRON FLUXES

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 4, Jul-Aug 82
(manuscript received 29 Jan 81) pp 114-117

DEMIDOV, B. A., KNIZHNIK, G. S. and TOMASHCHUK, Yu. R., Moscow

[Abstract] This work studies changes in the structure of steel types 30 and Kh18N9T, titanium alloy OT4, aluminum alloys D16T and AMg, and M1 copper as delivered, not subjected to any special heat treatment, Cylindrical

specimens 60 mm in diameter and 10, 20 and 40 mm thick were exposed to an electron beam in the center of the top surface, causing the formation of a crater. The pulse length was about 100 ns, power density 10^{15} - 10^{16} W/m², electron energy 0.35 MeV, focal spot diameter about 2 mm. Photomicrographs are presented of the structure of a type 30 steel specimen in various portions of the specimen after electron beam exposure. A broad area of structural changes and plastic deformations is produced by the beam, with several characteristic zones showing heat and plastic effects. Cracks are formed along the axis of the specimen in type 30 steel and OT4 alloy. Cracks are seen at the bottom of the crater in aluminum alloys. Figures 3; references 6: 5 Russian, 1 Western.
[185-6508]

UDC 621.791.01:669.538.6

USE OF PULSED HIGH FREQUENCY ELECTROMAGNETIC FIELD TO DOSE ELECTRODE METAL DROP TRANSFER

Kiev AVTOMATICHESKAYA SVARKA in Russian No 8, Aug 82
(manuscript received 25 Jan 82) pp 10-12

TARASOV, N. M., candidate of technical sciences, KAPUSTIN, S. S., engineer, Kharkov Aviation Institute imeni N. Ye. Zhukovskiy

[Abstract] A study is made of drop transfer, the mechanism of which is based on the interaction of the high frequency field of a solenoid with an induced current in the melted electrode metal. The effect of the solenoid field is independent of arc current. After a droplet of a certain mass is formed, the arc is used to heat the part. To create an axial force the electromagnetic field must have both axial and radial components. Therefore it is best to form the drop near the end of the inductor. High speed motion picture frames are presented of the process of separation and flight of a drop of M1 copper, mass 0.09 g. The head can be used for arc measured soldering of thin parts with copper and bronze, and surfacing of electric silver and silver alloy contacts on contact holders of steel, brass and bronze. Figures 5; references 4: 3 Russian, 1 Western.
[186-6508]

WELDABILITY OF ABM1 ALLOY WITH AMg6 ALLOY

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 9, Sep 82 pp 22-24

FOKANOV, A. N., engineer, KUROCHKO, R. S., candidate of technical sciences and PASTUKH, M. N., candidate of technical sciences

[Abstract] Plates measuring 300 x 100 x 2 mm of ABM1 alloy and AMg6 alloy were degreased with acetone after their edges were milled smooth to a roughness of 40 μ m. The acid film was removed from the ABM1 metal by etching at 20°C for 3 to 5 minutes in aqueous nitric acid and sodium fluoride with subsequent washing and drying. Automatic welding with argon jet protection of the outer surface and root of the seam was performed in a box isolating the welder from the effects of toxic beryllium aerosols. The wire used was type Sv-AMg6 and ABM1, 2 mm in diameter. The former wire did not provide good quality stable welded joint formation due to unsatisfactory melting of the wire with the AMg6 plate. ABM1 wire produced a significantly better joint in combination with displacement with the electrode by 0.5 mm in the direction of the plate of ABM1 alloy. High quality welded joints were produced with a short-term tensile strength of 347 MPa. The impact toughness of the metal with a stress concentrator in the form of a crack to various zones of the welded joint was greater than that of the base ABM1 metal. Figures 3; references 2: both Russian. [8-6508]

UDC: 621.791.755:621.791.658.5.011.46

METHODOLOGIC PROBLEMS OF DETERMINING ECONOMIC EXPEDIENCY OF PLASMA WELDING

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 9, Sep 82 pp 25-27

KHUTORSKOY, Yu. A., engineer and DIOMIDOVSKIY, A. D., candidate of technical sciences

[Abstract] Studies were performed to determine the economic expediency of plasma welding in carbon dioxide gas of large 09G2T steel members of the frame of the "Kirovets" tractor. Welding can be performed at various speeds: 50 to 60 meters per hour using a single arc plasmatron, 80 to 100 meters per hour with a 3 arc plasmatron. Analysis of the comparative economics indicated that the slower speed is best from the economic standpoint. The method used to calculate operating costs and capital investment for plasma welding of a meter of seam in order to select the economically optimal version is outlined. In certain cases, calculations can be simplified by eliminating the elements which have little influence on the overall cost of the operation. Figures 1; references 5: all Russian. [8-6508]

MISCELLANEOUS

UDC: 669.018.4

NEW TUNGSTEN- AND COBALT-FREE TOOL MATERIALS

Moscow TSVETNYYE METALLY in Russian No 9, Sep 82 pp 16-17

DORON'KIN, Ye. D.

[Abstract] The Institute of Chemistry, Urals Scientific Center, USSR Academy of Sciences, Institute of Material Science Problems, Ukrainian Academy of Sciences and Kiev Polytechnical Institute have performed fundamental physical-chemical studies in the area of synthesis and determination of the properties of a number of hard refractory metal compounds using group IVa and Va metals, and have recommended the use of compounds of titanium with carbon and nitrogen as tungsten-free hard alloys for the manufacture of tools. The National Research Institute of Hard Alloys has used these recommendations to develop a commercial technology for production of titanium carbide and titanium carbonitride based alloys. The Institute of Chemistry, Urals Scientific Center, has selected the composition $\text{TiC}_{0.5}\text{N}_{0.5}$ as the basis for hard alloys and has suggested an economical and technologically accessible method of its production (the carbothermic method). Type KNT16 titanium carbonitride alloy has been in production at the Kirovgrad Hard Alloy Plant since 1974. Type TN20 and TN50 tungsten-free tool alloys are also produced by the Dneprovskiy Hard Alloy Plant. The alloys have been introduced at more than 300 enterprises in the machine tool building, motor vehicle construction, agricultural machine building and other industries. State Standard OST-48-175-81 has been developed to guide consumers in the selection of tungsten-free hard alloys.

[9-6508]

INFLUENCE OF SUBSTRUCTURE ON HEAT RESISTANCE OF PLATINUM ALLOY

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 9,
Sep 82 pp 54-55

STEPANOVA, G. S., RYTVIN, Ye. I. and USIKOV, M. P., All-Union Scientific
Research Institute of Fiberglass-Reinforced Plastics and Glass Fibers;
Central Scientific Research Institute of Ferrous Metallurgy imeni I. P. Bardin

[Abstract] Results are presented from studies of the influence of the substructure on hardening of the alloys Pt + 10% Rh and Pt + 10% Rh + 10% Pd, 0.1% Ir + 0.1% Au at 1400°C with an initial stress of 4.9 MPa. Studies were performed on specimens measuring 5 x 0.5 mm, gauge length 40 mm, produced by rolling with 4, 6, 8, 10 and 40% deformation. After thermal etching and metallographic analysis, the electric spark method was used to cut blanks and prepare foils for electron microscope studies. The electron microscope studies established that the dislocation structure of specimens of the Pt-10% Rh alloy annealed after deformation of 6% consists of sections of grids and incomplete dislocation walls, while the structure of specimens annealed after 40% deformation is a typical recrystallization structure with clear, almost dislocation-free fields. The heat resistance of platinum group metal alloys depends on the nature of dislocation structures and the degree of structural perfection, which is determined by the degree of subcritical plastic deformation and subsequent annealing temperature. As the degree of subcritical deformation increases the annealing temperature at which a perfect polygonal structure is formed decreases. Figures 3; references 3: all Russian.
[5-6508]

DISSOLUTION OF γ' -PHASE IN NICKEL HEAT RESISTANT AGING ALLOYS

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 9,
Sep 82 pp 52-53

SAVITSKIY, Ye. M., BUROV, I. V., IVANYUSHENKO, Ye. V. and KOROL'KOV, V. A.

[Abstract] The method of contact potential difference was used to study processes of dissolution of the hardening γ' -phase in commercial heat resistant alloys KhN77TYuR and KhN70VMTYu when exposed to temperatures over the stable temperatures of the phase. The contact potential difference was measured under atmospheric conditions by a vibrating condenser relative to a gold electrode on an installation developed by the author. The degree of overheating of the specimen was determined from the structure using an electron microscope, and also from the Rockwell hardness. A decrease in the content

of γ' -phase causes an increase in contact potential difference. The intensity of the change in contact potential difference of alloys of this type when heated above the phase equilibrium temperature depends upon the quantity and stability of the hardening γ' -phase. The method of contact potential difference is recommended for nondestructive testing of these alloys to determine overheating. Figures 2; references 6: all Russian.
[5-6508]

UDC 669.245:620.178.746

REASONS FOR REDUCTION IN IMPACT TOUGHNESS OF KhN77TYuR-VD ALLOY AT ROOM TEMPERATURE

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 8, Aug 82 pp 53-55

KOTKIS, M. A., KUDRYAVTSEVA, G. P., ZIL'BERMAN, A. G., Gorkiy Motor Vehicle Plant; Moscow State University; ZIL Motor Vehicle Plant

[Abstract] A study was made of the heat resistance, impact toughness and fracture microstructure of KhN77TYuR-VD alloy specimens cut from forgings for motor vehicle turbine engine wheels so that the axis of the specimen was located tangentially to the disk blank. All forgings were heat treated before the specimens were cut by hardening from 1080°C in air, aging in 700°C 16 hours, cooling in air. It was found that though the mechanical properties are almost identical for all specimens, impact toughness and heat resistance may differ significantly. Low values of impact toughness at room temperature are characteristic for these specimens, which fracture through areas with elevated content of the Ni_3Ti hexagonal intermetallic phase. This phase can be formed in the steel when the content of titanium (and iron) is increased and the content of aluminum is decreased in microscopic volumes as a result of insufficient homogenization of the solid solution during heating before hardening. The hexagonal phase may also be segregated during deformation. References 1 Russian.
[178-6508]

ACOUSTICAL EMISSION UPON PHASE CONVERSIONS IN ALLOYS

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 8,
Aug 82 pp 30-36

VORONENKO, B. I., Gorkiy Research Institute of Physics and Technology

[Abstract] Acoustical emission refers to the emission of both sonic and ultrasonic stress waves in materials in which local dynamic restructuring of internal structure occurs. Acoustical emission occurs upon martensite conversion. This article establishes the variation between the temperature of beginning of the martensite conversion and the quantity of carbon in steel. The structure of the martensite formed is found to influence the intensity of acoustical emission. The distribution of AE amplitudes upon this conversion corresponds to the classical relationship of Ishimota for statistical seismology. In a number of light alloy metals, acoustical emission has been recorded upon welding and solidification. Studies performed on Pb-Sn alloys have shown that acoustical emission methods can be used to determine the melting and freezing points of pure metals, the liquidus and solidus lines, eutectic horizontal lines and lines limiting solubility in the solid state. The phenomenon of acoustical emission can be used to study the mechanism, kinetics and energy parameters of various state conversions, as well as to measure the rate of formation and growth of martensite crystals, to study preparatory processes, to establish incubation periods and early stages of the formation of martensite, to determine the type of kinetics, the structural mechanism and morphology and martensite formation, the formation and annihilation of conversion twins, and to determine the degree of cooperation of conversion, the presence and degree of the autocatalytic effect and the heterogeneity of shear deformation upon conversion. References 94: 37 Russian, 57 Western.
[178-6508]

STRUCTURE AND SUPERCONDUCTIVITY OF NIOBIUM-TITANIUM FILMS OBTAINED BY VACUUM ION-PLASMA ATOMIZATION

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 4, Jul-Aug 82
(manuscript received 17 Jul 80) pp 52-56

AZHAZHA, V. M., BERDNIK, A. P., BONDARENKO, V. N., KOLOT, V. Ya.,
LAPINA, N. V., REDKOKASHA, A. P. and SVINARENKO, A. P., Khar'kov

[Abstract] An ion-plasma evaporator was used to atomize the films in an "oil-free" vacuum obtained using a titanium sorption pump at about $1 \cdot 10^{-3}$ Pa. The substrate was copper foil heated by direct transmission of current from a stabilized power supply. The superconducting transition temperature of the

films produced was determined by the method of induction. For a given rate of deposition of the film its structure and critical temperature depend upon substrate temperature and are determined by gases from the residual atmosphere absorbed during condensation (primarily oxygen) and the interaction of the film and substrate. Figures 5; references 9: 5 Russian, 4 Western.
[185-6508]

UDC 669.018.25

INTERACTION OF TITANIUM CARBIDE AND CARBONITRIDE WITH NICKEL ALUMINIDE MELTS

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 4, Jul-Aug 82
(manuscript received 3 Dec 79) pp 40-44

TUMANOV, A. V., MITIN, B. S. and PANOV, V. S., Moscow

[Abstract] A study is presented of processes occurring when titanium carbide and carbonitride are wet by melts of NiAl and Ni_3Al . Studies were performed on hot pressed specimens of TiC and Ti(C, N) following grinding to maximum surface roughness $0.32\text{--}0.16\text{ }\mu\text{m}$ and alcohol rubbing. The nickel aluminide specimens were prepared by isostatic pressing of powders at 500 MPa. Analysis of the time and temperature variation of contact wetting angle in hydrogen showed that the equilibrium angle is established within 3-5 minutes, then remains unchanged for 20 minutes. Photomicrographs of the microstructure of the contact zone are presented. Wetting was better in hydrogen than in a vacuum. Chemical interactions predominated in the systems studied, with diffusion of aluminum into the refractory compounds along grain boundaries. The solubility of titanium carbide in Ni_3Al was found to be 1.0 mol. %. Figures 3; references 7: 5 Russian, 2 Western.
[185-6508]

UDC 669.24:6]1.77

PRODUCTION OF COMPLEX SHAPED CASTINGS OF POWDERED NICKEL ALLOY

Moscow TSVETNYYE METALLY in Russian No 8, Aug 82 pp 85-87

ANOSHKIN, N. F., BONDAREV, A. A., YERMANOK, M. Z., KLESHCHEV, A. S. and SOBOLEV, Yu. P.

[Abstract] Plastic deformation is effective for increasing the usage properties of products preliminarily compacted from granules of heat resistant nickel alloys. Special pressure working methods are needed for plastic deformation without disrupting the continuity of the specimens. An effective means of increasing the accuracy of stampings is the use of preliminarily polished compacts (preforms) of heat resistant alloy granules

obtained by hot isostatic pressing. To prevent intensive cooling of blanks, stamps of EI698 steel were heated to 700-750°C, then the surface of the blanks was protected with a thin heat insulating insert of stainless steel with an intermediate layer of zirconium dioxide. This system of insulation allowed the production of stampings practically corresponding to the stamp shape. Stamping and subsequent heat treatment produced mixed, partially recrystallized structures with small recrystallized grains surrounding larger unrecrystallized grains. This provides long term heat resistance. Stamping by this method allows production of products of rather complex shape in a single operation, increasing the utilization factor of the metal. Figures 2; references 8; 5 Russian, 3 Western.
[2-6508]

UDC 669:15.539.376

ESTIMATING RESIDUAL DURABILITY OF METAL MATERIALS

Kiev PROBLEMY PROCHNOSTI in Russian No 8, Aug 82
(manuscript received 19 Jan 82) pp 31-34

KOVPAK, V. I., Institute of Strength Problems, Ukrainian Academy of Sciences, Kiev

[Abstract] A study is made of some of the most obvious causes leading to increases in calculated residual durability according to the hypothesis of linear addition of residual durability. The factors resulting in elevated calculated durability include failure to consider creep phenomena and the transition from quasi-static to fatigue failure after a certain operating life. Final judgement concerning residual operating life can be made only by estimating the accumulated deformation during use and the deformation which will occur during subsequent use under the same conditions, requiring development of methods of reliable prediction of creep which would take into account the scattering of experimental data. Figures 5; references 13; 9 Russian, 4 Western.
[2-6508]

BEHAVIOR OF FIBERS IN ALTERNATING ELECTRIC FIELD DURING ELECTROFLOCCULATION

Kishinev ELEKTRONNAYA OBRABOTKA MATERIALOV in Russian No 4, Jul-Aug 82
(manuscript received 1 Sep 80) pp 34-36

SEMENOV, V. A., Leningrad

[Abstract] Results are presented from experiments using an electric field of variable frequency for electroflocculation. The signal from an audio oscillator was amplified and fed to the electroflocculator through a limiting resistor. It was found that at high frequencies the fibers striking the

lower electrode remained on it, preventing recharging. To determine the variation in fiber coating density as a function of interelectrode gap and fiber feed rate, a full factor experiment was performed. As fiber feed into the flocculation zone increased, the density of the fiber coating also increased. It was found that in a constant electric field the specimens were rapidly covered with the fiber, particularly with columns of fiber. In an alternating field recharging was so intensive that columns did not occur, probably a result of the increase in recharging time of the fibers with increasing layer thickness on the flocculated specimen. Figures 4; references 5: all Russian.

[1-6508]

PROBLEM OF DETERMINING NUMBER OF EROSION DISCHARGES DURING TIME OF ACTION OF SINGLE CURRENT PULSE

Kishinev ELEKTRONNAYA OBRABOTKA MATERIALOV in Russian No 4, Jul-Aug 82
(manuscript received 3 Mar 81) pp 59-61

KOSNIKOV, L. S., Moscow

[Abstract] A study is made of the number of existing erosion discharges considering the probabilistic nature of the random process of changing inter-electrode gap due to the presence of electrode surface roughness. For the case of growth or movement of the electrode in the gap, processing can be performed under conditions with high electrical parameters due to the increased breakup of the erosion discharge. References 6: 4 Russian, 2 Western.

[1-6508]

CSO: 1842

- END -